Discovery Dispatch

A Quarterly Newsletter of the NASA Discovery Program

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A Note From the Program Manager

Since August 15, the Discovery Program has been recovering from the loss of the CONTOUR spacecraft, which is presumed to be destroyed following what was expected to be a fairly routine maneuver to send CONTOUR on its way to Comet Encke. Ground-based observations indicate that the spacecraft is in at least three separate pieces on a trajectory away from Earth. A NASA investigation team is currently reviewing existing data in an attempt to determine what happened to the spacecraft. Using the Deep Space Network's antennae, APL and NASA will listen for a signal from the spacecraft in early December; however, the likelihood of hearing something is expected to be negligible.

On a brighter note, I would like to welcome Donald Sweetnam as the new Genesis Project Manager at JPL. Don takes over the helm from Chet Sasaki who has become the Kepler Project Manager. In other news, John McNamee has been named as Deep Impact Project Manager, taking over the arduous task of readying the DI impactor and flyby spacecraft for integration and test in preparation for launch in January 2004.

It is also my pleasure to congratulate Stardust on a highly successful flyby of the asteroid Annefrank on November 1. This flyby provided an excellent dress rehearsal for both the spacecraft and the operations team for their rendezvous with Comet Wild 2 in January 2004.

Straight from Hollywood, executive producer Shari Asplund has just released "Unlocking the Mysteries: NASA's Discovery Program." This 23-minute video presents a brief overview of the Discovery Program and the 10 science missions selected to date. The video looks back at the program on its 10-year anniversary - the program officially began in 1992 - and highlights the achievements that are helping scientists enhance our understanding of the Solar System. View an excerpt from the video on the Discovery Program home page.

Dave Jarrett

Flyby of Asteroid Annefrank Helps Stardust Prepare for Comet Encounter

As it continues to collect particles of interstellar dust on its way to Comet Wild-2, the Stardust spacecraft took advantage of flying near a small asteroid to test many of the procedures it will use during its January 2004 encounter with its primary science target.

Stardust passed within about 3,300 kilometers (2,050 miles) of asteroid Annefrank at 04:50 Nov. 2, Universal Time (8:50 p.m. Nov. 1, Pacific Standard Time). Stardust team members at the Jet Propulsion Laboratory (JPL) in Pasadena, CA, and at Lockheed Martin Astronautics (LMA) outside of Denver, CO, pulled off a tremendously successful close flyby of the main belt asteroid Annefrank. This flyby was used as an engineering test of the ground and spacecraft operations to be implemented at comet Wild 2 (pronounced "Vilt" 2) a little more than a year from now.

The close flyby of Annefrank offered a unique opportunity to thoroughly test all planned operations on the ground and on the spacecraft before

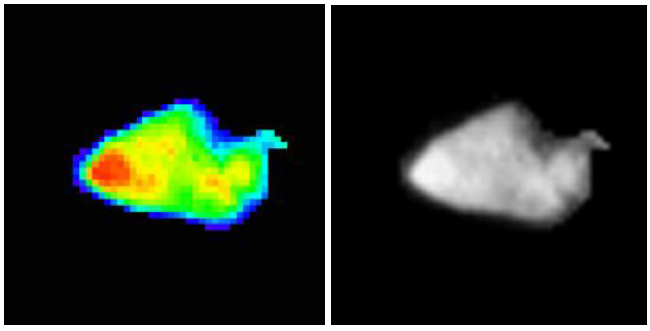

Image of Asteroid 5535 Annefrank taken by the Stardust spacecraft just prior to closest approach. The false color image on the left emphasizes variations in surface brightness.

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implementation at the comet. The goal was to test everything at Annefrank so that there would be nothing performed for the first time at Wild 2. Prof. Donald Brownlee, the Principal Investigator from the University of Washington, said, "We performed a full dress rehearsal with the cometary dust collector deployed, the spacecraft poised in its flyby attitude and with all science instruments on. The flyby has exceeded all of my expectations."

The main function to be tested during flyby was a sophisticated flight computer program that would take over control of the spacecraft to keep the camera viewing Annefrank during a 25 minute period around closest encounter. Over 70 encounter images were obtained that show a typical small solar system body, highly irregularly shaped and cratered. Annefrank is about twice as large as predicted, close to 8 km in diameter, but darker than expected and therefore more difficult to detect in the early images.

Not only did the camera perform well but the Dust Flux Measurement Instrument and the Cometary and Interstellar Dust Analyzer (CIDA) performed as expected. Dr. Jochen Kissel, Lead Scientist for CIDA from Max Planck Institute in Germany, said "I will be able to put CIDA into an even better configuration at Wild 2 based upon the Annefrank experience." Both dust instrument teams are combing through their data to see if by chance they may have seen a dust particle.

"Performing such flight testing before the primary encounter is a critical part of reducing risks and significantly increasing the probability of success when we reach Wild 2," said JPL Project Manager Thomas Duxbury. "We learned a lot at Annefrank that will improve our operations at Wild 2. The bottom line is that if Annefrank had been Wild 2, we would have succeeded in every respect," added Duxbury.

Even though this was an engineering test, the flyby with Annefrank provided new information about the asteroid's size, shape, spin state and brightness as a function of viewing angle.

"It was an exciting Friday evening for those of us involved in this mission," Brownlee said. "We captured images of a primitive asteroid with a highly significant name and one whose size turned out to be similar to the asteroid that likely killed the dinosaurs 65 million years ago. We have now validated Stardust's systems and operations, and we are eagerly awaiting our encounter with Comet Wild 2, just over one year from now".

The asteroid was discovered in 1942 and later named in honor of Anne Frank, who was immortalized by the diary she wrote during her years in hiding before being captured and taken to a Nazi concentration camp.

Education and Public Outreach Highlights

Stardust participated in the Solar System Educators Program annual training institute, held at JPL on August 7-11th. The training included a half-day devoted to comet missions Stardust, CONTOUR and Deep Impact. Educators learned about the importance of comet modeling and how mission parameters are determined based upon specific findings.

In August the Solar System Educator Program trained 30 master teachers at JPL.

The 30 educators who attended the training are part of the network of 50 volunteer educators who serve as "master trainers" to bring the excitement of solar system exploration to a diverse national audience of K-12 educators. The program uses formal classroom standards-based learning techniques, enabling the educators to provide inspiration and promote interest in science, mathematics, and technology learning among their students.

In September, an outreach representative for the mission presented a paper at the annual meeting of the Society for the Advancement of Chicanos and Native Americans in Science.

SSEP educators Kathy Chock, Hawaii, and Erich Landstrom, Florida, during the comet modeling portion of the training. The goal was to understand the comet environment for the Deep Impact and Stardust missions.

Stardust's outreach personnel presented information about the mission during two conferences in Houston in October: the World Space Congress and the International Council for Science's Committee on Space Research.

Stardust has added five new museum/planetarium partners to its current 14 partnerships. Displays can now be found in the Pasadena Historical Museum, the San Jose Tech Center, the Fleischmann Science Center, the East Kentucky Science Center, and soon at the Franklin Planetarium.

Contact Lost with CONTOUR

After a spectacular nighttime launch that lit up the Florida sky on July 3, the CONTOUR spacecraft spent six weeks in Earth orbit. On Aug. 15, CONTOUR's solid-propellant rocket motor was programmed to ignite at 4:49 a.m. EDT, giving CONTOUR enough boost to escape Earth's orbit. At that time, CONTOUR was about 140 miles above the Indian Ocean and out of radio contact with controllers. The CONTOUR mission operations team at APL expected to regain contact at approximately 5:35 a.m. EDT to confirm the burn, but NASA's Deep Space Network (DSN) antennas did not acquire a signal.

Artist's concept of the CONTOUR spacecraft.

Since then, there has been no contact with CONTOUR. Commands pre-programmed into the spacecraft's flight computer system, designed to instruct the spacecraft to try various alternate methods of contacting Earth when contact is lost, also have not worked to date.

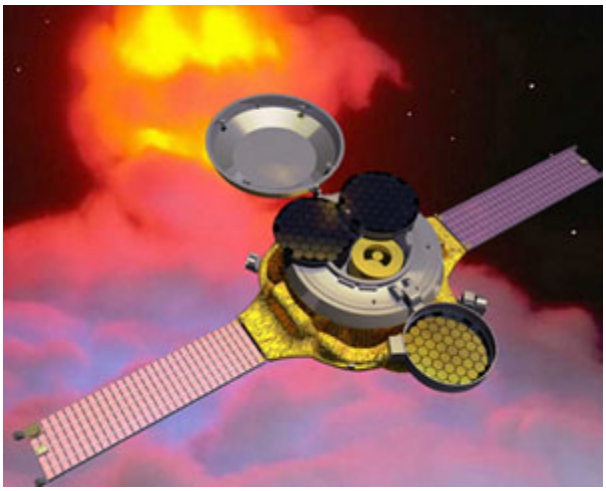
Images from a Spacewatch ground-based telescope at Kitt Peak, AZ, show three objects at the location where CONTOUR was predicted to be, images which may indicate the spacecraft has broken apart. Mission controllers at APL will listen for signals from the spacecraft in early December, when CONTOUR will come into a more favorable angle for receiving a signal from Earth.

On August 26, NASA Administrator Sean O'Keefe announced that Chief Engineer Theron M. Bradley Jr. would lead a team to investigate the apparent loss of the CONTOUR space probe. The investigation team will independently examine all aspects of the CONTOUR mission.

In May, Bradley joined the agency as Chief Engineer to provide independent technical review of NASA's programs and projects. The team includes internal NASA investigators from space science, as well as other aerospace disciplines, and external experts with extensive experience in accident examinations. The group is expected to report its initial findings to NASA Headquarters in six to eight weeks.

Genesis Science Collection Continues

Congratulations to Don Sweetnam, who was appointed Genesis project manager in October, succeeding Chet Sasaki. Ed Hirst succeeds Sweetnam as acting mission manager. Sasaki has moved on to become manager of Kepler, another Discovery mission.



Artist's concept of the Genesis spacecraft.

At the end of October, all systems on Genesis are functioning properly. The solar wind samples collected in the past few weeks included the high-speed type from the Sun's coronal holes. The spacecraft deployed its collector array for that type of solar wind for the first time in a month. Genesis uses different arrays for sampling each of three different regimes of solar wind.

The flight team is preparing to upload to the spacecraft a software patch that will increase the number of temperature-sensor readings by the sample return capsule's avionics unit.

In late September the flight team and spacecraft completed a sixth stationkeeping maneuver without a hitch, to adjust the orbit that Genesis is traveling around the L1 point. It accelerated the spacecraft by about 1.45 meters per second (4.76 feet per second) in a direction about 22 degrees off a line toward the Sun. Initial results from the navigation team indicate that the execution was within about 1 percent of design.

The Genesis team received a NASA Group Achievement Award on Sept. 24 for "outstanding contribution to successful development,

test, and launch of the Genesis spacecraft and the implementation of an outstanding mission operations system." Lockheed Martin Astronautics and Boeing were each awarded a NASA Public Service Award for Genesis development and launch.

With less than two years remaining until Genesis returns its collected material to Earth on Sept. 8, 2004, a meeting to further planning for the sample return operations at the U.S. military's Utah Test and Training Range took place in early September. Participants included Genesis team members from the Caltech, JPL, NASA's Johnson Space Center, Los Alamos National Laboratory, Lockheed Martin Astronautics, and McREL, along with representatives from the Utah Test and Training Range, Hill Air Force Base and the U.S. Air Force Space Command. Participants discussed the release, entry, mid-air recovery and handling of the samples.

Education and Public Outreach Highlights

Members of the Genesis mission science community have written a number of articles based on the mission and the technical rationale for sample collection.

According to Genesis Co-Investigator Roger Wiens at Los Alamos National Laboratory (LANL), "The solar system was created four and a half billion years ago from a cloud of gas and dust. We know the dates from asteroids, moon rocks and our own Earth, but we don't know the details of how the solar system was formed. Genesis is one of the few NASA missions that addresses this."

Read about the science of the mission, its instrumentation, collector materials, and more by visiting the publications page on the LANL Genesis site.

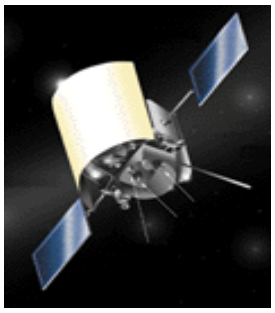
Also at LANL, Bruce Barraclough was responsible for the design, development, fabrication, testing, and flight operation of the Genesis Electron Monitor (GEM) and Genesis Ion Monitor (GIM). In a recent interview, Bruce talks about his work and the challenge of bridging the disciplines of science and engineering.

"We defined the science to be accomplished," he said, "and then had to translate that into hardware that would accomplish the science goals. The plan is to analyze a very few atoms that are implanted in the returned sample materials, determine what the present composition of the outer layers of the sun is, and use this information to help us understand the condensation of the early solar nebula into the planets, comets, and asteroids 4.5 billion years ago."

Read more about Bruce's challenges on Genesis, his background, career path, and advice for young scientists and engineers.

MESSENGER Development Progresses

The MESSENGER team is extremely busy with fabrication, assembly, test and integration of the spacecraft, science instruments and subsystems.



MESSENGER spacecraft

In September, science team activities centered on preparation for the Science Operations Center Critical Design Review, held on 30 September and the Science Team meeting on 1 October. Presentations on MESSENGER were made at the World Space Congress in October in Houston, TX.

The Project Scientist has been participating in weekly coordination meetings with representatives of the APL Technical Services Department who are building much of the flight hardware, especially for the APL-supplied instruments.

August efforts centered on monitoring instrument and spacecraft activities as these move into fabrication to ensure that the science goals can be met with the flight units. Instrument calibration plans for MESSENGER's science instruments were finalized, with reviews for each calibration plan taking place during July, August, and September.

Education and Public Outreach Highlights

NASA's Minority University-Space Interdisciplinary Network (MU-SPIN), a MESSENGER E/PO partner, is offering an intern program for undergraduate scholars. Qualified minority students majoring in NASA-related disciplines will have the opportunity to assist the mission project staff in their work at APL in Laurel, MD, and gain valuable experience.

Click here to view the currently open positions. It is anticipated that additional positions will become available as the MESSENGER mission progresses.

Work continues on revising the MESSENGER website. Writers, filmmakers, educators, scientists, and engineers are working together to bring the exciting science of MESSENGER to everyone. The plan is to provide a wealth of resources about the planet Mercury and about the MESSENGER mission. For students and teachers there will be special sections containing educational materials and opportunities.

Four MESSENGER presentations will be given in Washington D.C. public schools this fall with classroom teachers at the third, fifth and sixth grade levels. Two will be part of space science themes, and two will be presented as part of social studies units on exploration and discovery.

Development of MESSENGER Education Modules (MEMs) continues, with activities related to the mission's Scientific Process theme. These include six lessons for the 5-8 level and six for the 9-12 level. The first elementary school lessons, Designing to Stay Cool, are being field-tested. An astronomy workshop at the National Science Teachers Association conference in August introduced the activities to participants and served as a means to solicit comments from teachers.

Deep Impact on Track for 2004 Launch

Development of the Deep Impact two-part spacecraft and its science instruments continues on schedule toward a January 2004 launch. In August, the flight structures, the metal frameworks that form the backbone of each spacecraft, were subjected to vibration tests at Ball Aerospace in Boulder, CO, to simulate launch aboard a Delta II rocket from Cape Canaveral. In coming months, the two spacecraft skeletons will be further developed and the science instruments will be added. Deep Impact is scheduled to leave Boulder in October 2003.

Deep Impact educational poster

Education and Public Outreach Highlights

Deep Impact project members spent the summer giving workshops for educators from across the country. The NASA Educational Workshop (NEW) and the Solar System Educators Program for master teachers brought some 60 teachers to the Jet Propulsion Laboratory for training. Since the new school year began, about 30 members of the Deep Impact project have headed into classrooms and given public presentations to share the excitement of digging beneath the surface of a comet. Deep Impact entered the video conference arena with a training to a high school class in Pennsylvania on the subject of modeling challenges for mission success.

Deep Impact and Stardust representatives partnered in a workshop for the Society for Advancement of Chicanos and Native Americans in Science (SACNAS). The theme for the workshop centered on "Modeling for Success of a Mission." Project representatives discussed the science and technical challenges for both missions and the modeling exercises carried out by each to ensure mission success.

Deep Impact participated in the National Girl Scout Conference in Long Beach, CA, in October, bringing the "Make a Comet and Eat it" ice cream and "Comet on a Stick" modeling activities as demonstrations.

The Deep Impact mission was represented at several astronomy gatherings in the mid-Atlantic Region, talking about the mission and recruiting amateur observers for two Deep Impact programs: Small Telescope Science Program (STSP) and the Amateur Observers program. In addition, a new Deep Impact subsite is being developed aimed at the casual observer/amateur astronomy community. The new site will give specifics on how to find and observe comets, the mission's target Comet Tempel 1, in particular. The program will be written for both skilled observers as well as the general public looking at the site in the last few days before the Deep Impact encounter with the comet in July 2005.

Exciting additions were made to the Deep Impact web site recently, including three new educational activities: Make a Comet and Eat it, Comet On a Stick, and Exploring Comets and Modeling for Mission Success. While the titles are catchy, the three activities allow students to explore their own understanding of the nature of comets. They then compare their theories to the current science community's knowledge of comets, and the role comet's played in the formation of the solar system. Students have the chance to understand how the Deep Impact mission will contribute to that knowledge.

NASA Awards Kepler Contract

NASA has awarded a contract with a potential value of $28.4 million to Ball Aerospace and Technology Corp. (BATC), Boulder, CO, for development of the optics and detectors for a high-tech camera for the Kepler planet-finding spacecraft, scheduled for launch in 2007.

Kepler spacecraft

Eastman Kodak will provide the entire optical subsystem for the spacecraft, a contract valued at $4.5 million for a two-year period. Kodak is providing a unique optical subsystem for Kepler, unlike anything flown in space before. The two-piece system gives Kepler an extremely wide field of view, allowing it to continuously gaze at more than 100,000 stars at the same time.

Other major subcontractors are Semiconductor Technology Associates in San Juan Capistrano, CA, and EV2 of Elmsford, NY, who are providing detectors for Kepler.

The Kepler Mission differs from previous ways of looking for planets, which have led to the discovery of about 100 giant Jupiter-sized planets. Kepler will look for the "transit" signature that occurs each time a planet crosses the line-of-sight between a planet's parent star, the one it orbits, and the observer. During the orbital "transit," the planet blocks some of the light from its parent star resulting in periodic dimming. This periodic signature is used to detect the planet and to determine its size and orbit. Kepler will be able to determine if any Earth-sized planets make a transit across any of the stars.

"With its cutting-edge capability, Kepler may help us answer one of the most enduring questions humans have asked throughout history: 'are there other planets like Earth in the universe?'" said principal investigator William Borucki of NASA's Ames Research Center, Moffett Field, CA, leader of the mission.

News about NEAR

Technology inspired by the NEAR mission will soon be helping solve murder cases far faster. A simple handheld device that instantly confirms whether a suspect has recently fired a gun means lab delays will not allow suspects time to get away.

The idea for the device was hatched under a new collaboration between NASA and the US National Institute of Justice. The plan is to adapt taxpayer-funded space research to fight terrestrial crime. Jacob Trombka, a member of the NEAR mission team and a physicist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, set the ball rolling. He believes X-ray fluorescence (XRF) could be a key crime-fighting technology. X-ray fluorescence spectrometry can identify the chemical elements in a substance by measuring the wavelengths it emits when exposed to X-rays. NEAR's sensors simply recorded cosmic X-rays bouncing off the asteroid and beamed the details of the emissions back to Earth.

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